33 Earth Processes and Boomtown's Coast

READING

Although a beach is not one of the possible building sites, Boomtown is a coastal community and the beach is important to the area. The Town Beach is a landform that is directly related to the three possible sites. Rain and sediments run down Green Hill to the Rolling River. The river then transports the water and sediments to the ocean at the Delta Wetlands, where they become a part of the beach. Likewise, eroded material from Seaside Cliff adds material to the beach.

Some geologists are interested by beaches because beaches are subject to repeated weathering, erosion, and deposition. Beaches are always changing because they are a part of a larger, dynamic system of earth processes.

CHALLENGE

How is a beach part of a coastal system?

A river meets the ocean at this beach.

READING

Beach Formation

There are many kinds of beaches, with different shapes, types of sand, and waves of various sizes. The appearance of a beach depends on many factors, such as the wave energy of the ocean, the sediment supply from the river, the earth material in the area, the tides and the seasons, and the weather. Of these factors, the most important ones are the amount of sediment moved to the coast by the river and the amount of wave energy hitting the shore.

Beaches are most commonly found near the mouth of a river where sediments are deposited. A beach will form when the amount of sediment supplied by the river is in balance with the erosion energy of the ocean waves. In other words, a beach has equal and opposite forces: the constructive force of sediment deposition is roughly the same as the destructive force of the waves eroding the sediments.

Listen as your teacher reads aloud.

Stop when you see this yellow pencil and close your book.

Write down the main ideas you just heard.

A Naturally Changing Coastline

When the sediment supply from the river is much more than the ocean waves can erode, a delta will form. This happens at a coastline when the constructive force of deposition dominates over the destructive force of erosion. Deltas are typically formed on coastlines with large rivers. In fact, almost every major river builds a delta at its mouth. If the delta continues to form, it will extend the beach, or coastline, towards the ocean.

When the force of the ocean waves is much greater than the amount of sediment deposited by the river, the destructive force of erosion dominates the force of deposition. The result is a coastline that erodes and retreats inland. A beach can be washed away in this situation, or a cliff can form from any nearby high land. When a shore or coast is actively eroded, the effect can be dramatic because of the large force of ocean waves.

Longshore Current

Every time an ocean wave hits the beach, it picks up millions of sand grains and moves them. Sand is continually moved off shore and then back again. But sand doesn't just move in and out from the beach. Because waves hit the shoreline at an angle, sand is pushed across the shore as well as in and out. The **longshore current,** which is a result of waves hitting the beach at an angle, is a stream of water in the ocean that runs parallel to the shore and moves sand across the face of the beach. (See Figure 1 below.) The longshore current lengthens a beach by transporting sand and sediments away from the mouth of a river.

When humans build near the beach, there can be a large environmental impact because of the high activity of the earth processes there. One problem that is created when buildings, bridges, or harbors are placed on the shore is the interruption of the longshore current. When water in the longshore current travels around a structure, it slows down, causing sand and sediments to settle out of the water. This results in excessive deposition of sand near the structure.

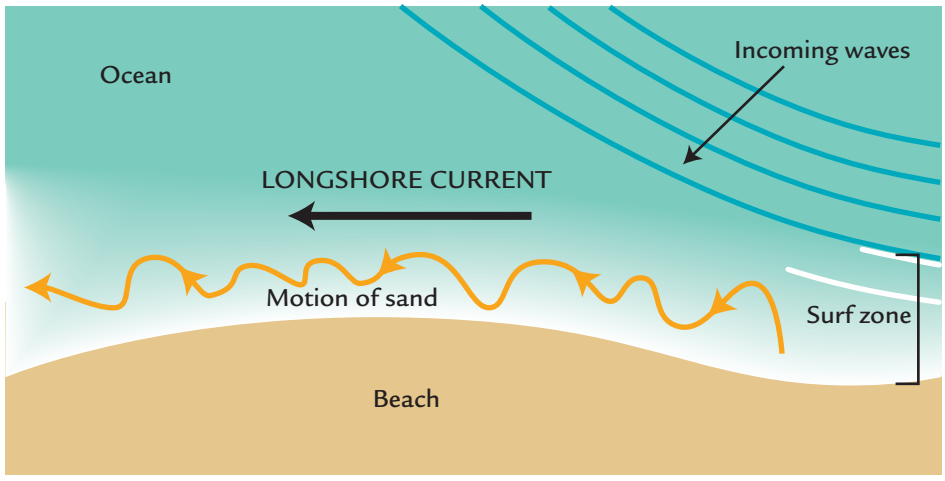

Figure 1: Longshore current

Managing Earth Processes

One way to protect the beach from the problem of unwanted deposition is to dig up the sand and move it to another location. Dredging is often successful, but it's a lot of work. It can also expose contaminated sediments, and can make the land less stable. A **jetty**—a rock structure built perpendicular to the shore—can help avoid the problem of unwanted deposition by collecting the sand on one side of it before it

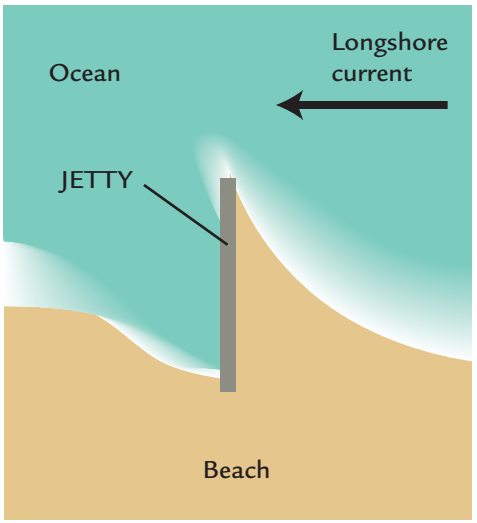

Figure 2: Jetty

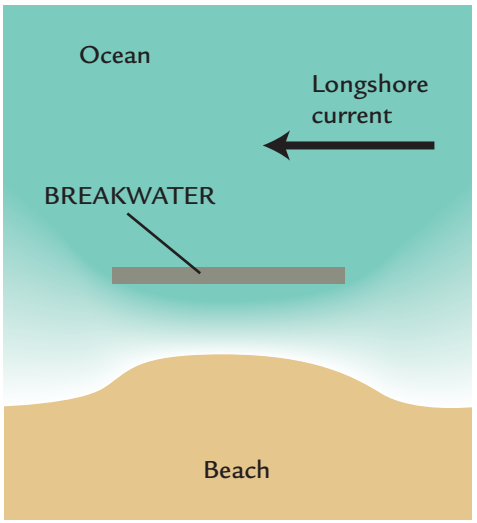

Figure 3: Breakwater

reaches the structure. Jetties are often used in harbors to prevent the harbor from filling in with sediment. (See Figure 2 above). Although a jetty will increase deposition on the upstream side of the jetty, the other side of the barrier will erode and narrow the beach there.

Another common problem associated with building on the shore is erosion caused by the force of ocean waves, which may make the land beneath the buildings unstable. One way to slow down this erosion is to reduce the energy of the waves. A **breakwater**—a rock structure that is built parallel to the shore—may slow erosion by reducing the wave energy that hits the shore. (See Figure 3 above.) However, the breakwater also slows down the longshore current, so that sediments in the longshore current are deposited in between the breakwater and the beach.

Sometimes piles of rock (called *riprap*) or **seawalls** are built right up against the cliff or shoreline. Ocean waves hit the structure instead of the cliff, reducing the wave energy and the amount of erosion. The erosion around the seawall, however, is often increased because waves are redirected there.

Dredging and building jetties, breakwaters, and seawalls are only some of the ways communities attempt to protect their coastlines. All of these approaches are effective, but have undesirable consequences. These structures can be effective for a while, but the protection is temporary. Eventually, the waves and longshore current will destroy any attempts to hold back the sea.

ANALYSIS

1. Describe how each of the landforms below contribute sediments to the Town Beach in Boomtown.
   - **a.** Seaside Cliff
   - **b.** Delta Wetlands
   - **c.** Green Hills
   - **d.** Rolling River

2. Look at the topographical maps of Boomtown over the last 100 years on Student Sheet 26.1, "Maps of Boomtown 100 Years Ago," Student Sheet 26.2, "Maps of Boomtown 20 Years Ago," and Student Sheet 26.3, "Maps of Boomtown Today." At the Delta Wetlands, is the constructive force of deposition greater, less than, or equal to the destructive force of erosion? Explain your answer using evidence from the maps.

3. Prepare a concept map for beaches and coastal systems. Be sure to use the following terms:

coastal system	beach	dredging
erosion	delta	jetty
deposition	cliff	breakwater
balanced	hill	seawall
longshore current	river	

4. Choose a method that helps control either erosion or deposition on the coastline. For the method you choose, describe both an advantage and a disadvantage of its use.

EXTENSION

Visit the *Issues and Earth Science* page on the SEPUP website for more information and dramatic photographs of beach and cliff erosion.